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NEW SUBSTITUTES FOR NONFERROUS METALS IN THE USSR

SUBSTITUTION OF PLASTICS FOR NONFERROUS METALS

G. Vashin

The development of synthetic materials production in the USSR will result in a great saving of valuable metals, will reduce the cost of machine tool and tool production, and will in many cases simplify the technology of production.

A great deal of work on substitutes for nonferrous and ferrous metals, as well as on anticorrosion factors, has been carried out by the Derbenevskiy Chemical Plant imeni Stalin. This work is based on the important successes of domestic industry in the production of new anticorrosion synthetic materials, such as vinyl plastic, polyisobutylene, impregnated graphite, etc. The use of substitutes has already resulted in a considerable saving in metals, especially nonferrous. In cases where the use of plastics for entire articles is not possible, it is permissible to substitute ferrous for nonferrous metals in order to give high anticorrosive properties to manufactured articles by means of linings, internal coverings, etc.

Before the introduction of new substitutes, lead was a basic material, used for the manufacture of and as a safeguard for many kinds of chemical apparatus. It was employed in the production of pipes used to transport acid and intermediate acid products, and for the protection of steel and wooden chemical apparatus, depositories, measuring tanks for the manufacture of spiral tubes, etc.

In recent years, important steps in replacing nonferrous metals by plastic materials have been taken at the plant, resulting in a great saving of nonferrous metals. Several years' experience has shown the expediency of such substitutes.

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Substitutes were introduced for two purposes: to replace parts manufactured completely from nonferrous or ferrous metals, and to serve as protective anticorrosive layers and linings. Thereby lead is freed and the wide use of ferrous metal is made possible.

The large expenditure of lead has decreased in a number of pipes widely used in chemical production. These include technological, acid, industrial pipes, etc. The lead pipes used formerly were replaced by vinyl plastic pipes. Despite work in a reactive medium -- acid and alkaline -- and a widely fluctuating temperature range (from minus 30 to plus 55 degrees centigrade), these pipes have already been used successfully for 4 to 5 years. Up to the present, the vinyl plastic has shown no signs of deterioration.

Heretofore, a large quantity of lead has also been used up in protective layers designed to cover the internal surfaces of tanks, vats, and hoppers of filter presses. Now the lead lining has been replaced by linings of vinyl plastic, polyisobutylene, silicate diatomic, or faolite, which have already been used for 2 or 3 years without appreciable traces of disintegration. In the casings of "Sirokko" ventilators the lead covering has also been replaced by vinyl plastic, polyisobutylene, or faolite, depending on operating conditions.

The original method of replacing nonferrous by ferrous metal is the use of steel pipes for refrigerator coils. As protection against the action of reactive matter, enamel is used in this case to cover the external surface of the pipe. The results of operation have shown the need, under certain conditions, of good heat-conducting material. Steel enameled coils have served well for up to 2 years.

In many cases plastics were also used to replace steel parts or protect them from the reaction of chemical products. The same substitutes have been introduced in the installation of measuring tanks, hoppers, and depositories with a capacity from 100 to 10,000 liters. In ventilators and exhaust fans steel has been replaced by vinyl plastic. A 4-year trial of these properties has shown the expediency of the further use of substitutes under such conditions. Signs of chemical disintegration of the parts have not yet been detected.

Finally, plastic substitutes have been used for the manufacture of various small parts and objects. During the past year, vinyl plastic shutoff armatures have been used at the plant, as well as vinyl plastic buckets for the overflow of acid, vinyl plastic parts for pumps, etc. This has made it possible to save a large quantity of valuable metals.

Through the use of substitutes, the plant has achieved a very great saving of valuable lead. The economy of the main operations depends in large part on the cheap and simple introduction of new substitutes, above all vinyl plastic and polyisobutylene.

For example, vinyl plastic, produced in the form of sheets of varying thickness, pipes, welding wire, and other articles, is easily processed both by hand and mechanically. Therefore, the cost of using it will be very low. Like polyisobutylene, it is proof against almost all acids, alkalies, and solutions used in chemical production. Vinyl plastic is easily weldable in a jet of hot air. This makes it possible to manufacture various types of structures from it and to repair them rapidly.

To cover the internal surfaces of containers with vinyl plastic, a special calendered coating having a thickness of from 0.35 to 1 millimeter is used at the plant. It is possible to cover any container with this coating, including

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containers made from low-melting materials, because in the application of the coating to the internal surface of the container its external surface must be heated up to 140-180 degrees centigrade. To control the quality of the coating, the spark method and the electrolytic method, based upon the good dielectric qualities of the vinyl plastic, are used.

Polyisobutylene, in addition to the uses mentioned, may also be employed as a protective agent for concrete and wooden structures which are exposed to the action of reactive fluids, vapors, and gases. Polyisobutylene, manufactured in sheets 1.5-2 millimeters thick, when used as a lining does not require the heating of the sides or bottom of the covered container.

When vinyl plastic is applied, the internal surface of the container should be carefully cleaned by mechanical or chemical means. The sizing is applied to it in three successive layers; therefore, before the application of the next layer the preceding one must first be dry. At the same time, it is necessary to avoid completely dry sizing. Polyisobutylene sheets, after cleaning and rinsing, are also smeared with the sizing, after which the gaiting operation is carried out. The union of polyisobutylene sheets is accomplished by welding, which results in a stronger bond than gluing.

The economic effectiveness of using these substances in the national economy is evident. Besides releasing nonferrous metals for other uses, the use of synthetic materials makes it possible to simplify the manufacture of machines and apparatus and to reduce their weight. Besides this, it improves the quality and lowers the cost of many machines and devices.

A number of branches of industry, such as nonferrous metallurgy, machine building, machine-tool building, petroleum, textile, and food, already use vinyl plastic and polyisobutylene as substitutes for nonferrous metals and to guard ferrous metals against corrosion. Without a doubt, the use of these materials will be developed further and Soviet chemists will in the near future give to industry new and still cheaper and stronger materials.

SAVING OF NONFERROUS METALS

V. Efimov

The party and government are evincing great interest in the problem of saving and rationalizing the use of material resources, in particular nonferrous metals. In addition to the saving of raw materials, of prime importance to the national economy are the measures taken in the chemical industry for the replacement of lead and other valuable nonferrous metals used for the production of pipes, ventilators, pumps, stopcocks (taps), and other items.

The Dorogomilovskiy Chemical Plant neari Frunze has done a great deal in saving nonferrous metals, particularly lead, by using substitutes.

The most important substitutes for nonferrous metals are tentolite and faolite. Tentolite is a fabric impregnated with a bachelite resin; faolite is a plastic prepared from phenolformaldehyde resin which uses asbestos as a filler.

Before the introduction of these, a large quantity of the pipe at the plant was manufactured from lead and other valuable metals. But this pipe was quickly put out of commission by the action upon it of reactive agents (acids).

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The use of substitutes made it possible to eliminate this serious defect and to save a significant amount of nonferrous metal. Thus, each month the plant, over a period of years, has produced in a special shop 550-650 meters of miscellaneous pipes with diameters up to 2 inches from textolite.

To save lead, the plant has also produced faolite-textolite pipes, the internal part of which is made of faolite and the external part of textolite.

Important work in saving bronze is also being done at the plant. This economy has been achieved by substituting iron-faolite stopcocks for bronze ones. The surface of these stopcocks, which are made of iron, is coated with faolite. This operation has permitted the manufacture of about 300 such stopcocks, ranging in size from 1 to 4 inches, per month and has saved a large quantity of bronze.

Miscellaneous dismountable agitators are being manufactured from faolite. Furthermore, in order to replace lead used to coat rotor and frame agitators, an external coat of faolite is applied which protects them from the action of organic and inorganic acids.

It should be noted that articles to which faolite has been applied retain their durability at temperatures up to 120 degrees, while those to which textolite has been applied cannot be subjected to temperatures above 80 degrees. The latter react unfavorably to alkalis, nitric acid, and monohydrates.

At present, the plant is conducting experiments in substitutes for lead coils used to heat reactive masses in various apparatus. These coils may be replaced by lining the apparatus with heat-conducting flakes. The lining consists of graphitic flakes impregnated with phenoformaldehyde resin. The lining itself comes in a special heat-conducting paste. This makes it possible to save the lead used heretofore to protect the apparatus. As a result of replacing lead articles with textolite and faolite articles the plant saved about 18 tons of lead in 1951.

Important work in the introduction of vinyl plastic articles is also being undertaken at the plant. Vinyl plastic items are being introduced for use under circumstances where the temperature does not exceed 50 degrees, since at higher temperatures it is unstable. Vinyl plastic is used in place of metallic ventilator pipes, as well as for miscellaneous gas pipes manufactured from metal. During the first half of 1952 alone, miscellaneous vinyl plastic items with a total weight of 9 tons were put into use.

The indicated substitutes for nonferrous metals are used at the plant not only for the manufacture of parts and small articles of small shapes and simple form, but also for the production of parts of large sizes and complicated shapes. Thus, the process for the manufacture of faolite parts for centrifugal pumps has now been mastered. First, a press form is assembled for the production of these parts. The inside of this press form is rubbed and lubricated with a special machine oil. Then the 36 corner irons (ugol'nik) are trimmed with emery paper and lubricated with oil. The cleaned and lubricated corner irons are screwed to the internal wall of the press form. Then the two plates are covered and lubricated, and the assembled press form is put into the furnace and heated.

The next operation is the preparation of the faolite for pressing. Large chunks of faolite are cut into small pieces by a special knife attached to a hydraulic press. The small pieces of faolite, weighing a total of 30 kilograms, are loaded on a pan and put into the furnace and a softening of the mass takes place. At the same time, a steel bar weighing 45 kilograms is taken and thrust into the furnace for heating. Then the press form is compressed. The trolley holding the press form is withdrawn from the furnace, and the hot press form is rubbed and lubricated with oil.

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The softened mass of faolite is put by hand into the recess of the press form and, to make it solid, special metal flakes are stamped in. After all the crevices are filled, the heated steel bar is inserted and all the spaces are filled with faolite. The plates are gradually tightened with bolts. As the press form is contracted, the excess faolite is forced back through the openings in the plates. The plates are contracted until they make contact with the press form.

In the process of contracting the plates, the whole press form is put into the furnace for an hour for a second heating. After compression in the press form, it is necessary to subject the items in the furnace to a temperature ranging from 138 to 140 degrees (polymerization). After the furnace has cooled, the press form is taken out. The whole process of polymerization lasts 24 hours. The faolite mass solidifies and attains the required strength.

Articles of textolite and faolite are now beginning to be used widely in chemical plants. These items have won for themselves a permanent place, because their durability and resistance to reactive liquids is considerably higher than those of items manufactured from metal. Further work on the use of substitutes for nonferrous metals promises still greater results, as well as the saving of a significant quantity of valuable nonferrous metals.

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